HDOT X STEMWORKS BRIDGE BUILDER COMPETITION

HANDS-ON ENGINEERING MEETS REAL-WORLD IMPACT

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DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

Bentley® Education

Guidelines for Grades 11-12

Key Dates	Registration Deadline	In-Person Bridge Builder Training	Proposals Due	Finalists Announced	STEMworks Competition
	Sep. 26, 2025	*Oct. 14, 2025*	*Feb. 6, 2026*	*March, 6, 2026*	*April 15, 2026*

2025-26 HDOT x STEMworks Bridge Builder Competition Guidelines

PLEASE THOROUGHLY READ ALL SECTIONS OF THIS DOCUMENT TO ENSURE ADHERENCE TO THE COMPETITION GUIDELINES. RULES AND SPECIFICATIONS CHANGE EACH YEAR.

The Competition:

This event is designed to allow students the opportunity to develop a **Truss Bridge** that will be tested for strength-to-weight ratio. Student teams from grades 11 and 12 will be competing against other STEMworks student teams from across the state. STEM Outreach Solutions Headquarters will send a STEM Outreach Solutions Bridge Builder Module Kit to each school with supplemental bundles to begin their project. Only materials included in the kit supplied by STEM Outreach Solutions Headquarters can be used in the construction of the bridge.

Suggested software:

1. Bentley MicroStation Software (instructions are provided in a separate document)
2. ModelSmart 3D (provided in Bridge Module)
3. Free CAD Software (Tinkercad)

Other materials needed not provided in kit:

- Supplies in AASHTO STEM Outreach Solutions Bridge Builder Module
- School Supplies (pencil, paper, scissors, rulers, computer)

After completing the project, each team is required to submit a digital copy as a single file named as your school name, team name and saved as a PDF, Example: *[SchoolAbbrev]_[TeamNumber].pdf*, to Chelsea Kau, the Outreach & Communications Specialist at ckau@gotoetc.com. You must include pictures of the final built bridge and label it as the competition bridge. The proposal must be received no later than **February 6, 2026**. Finalists will be notified by **March 6, 2026**. At the Finals, teams will present a 10-minute PowerPoint presentation and structurally test their bridges against teams from other schools to determine the winning bridge.

Who Can Enter?

- Students must be in grades 11^{th} or 12^{th}.
- Teams shall be composed of two (2) members. NOTE: If your student is applying as an individual, please indicate so on our registration form.

The Problem:

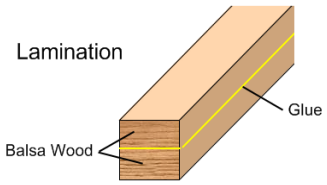
The goal of this competition is to develop a **Truss Bridge** that will carry as much weight as possible while weighing as little as possible (strength-to-weight ratio). Each team is to research the bridge type, design, and conduct experiments to test for strength-to-weight ratio, and then design a bridge resulting from those experiments. The teams are to construct a bridge **made only with the materials provided** in the STEM Outreach Solutions Bridge Builder Kit. As a part of the Design Competition, the team is required to develop a report portfolio describing the design and testing of the bridge and create design drawings using computer-aided design (CAD) software. Each bridge will be checked for design according to the rules. The bridges will be weighed, and strength tested during the competition to calculate strength-to-weight ratio. Bridges will be subjected to material tests after a strength test is performed.

The Challenge:

An engineer's job is to not only design a safe bridge to carry required loads, but also to make sure that it is cost effective (least amount of materials used to achieve the desired load). To simulate this process, teams will use the following strength-to-weight ratio calculation to develop a bridge that carries a high load relative to the bridge weight. Strength to weight ratio is determined by dividing the maximum load carried by the weight of bridge.

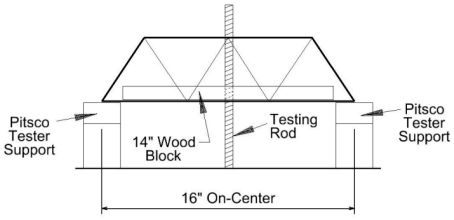
Example: Maximum load = 120.0 pounds
Bridge weight = 20.0 grams
Ratio = 2724.0
[(120 pounds x 454g/pound) / 20 g]

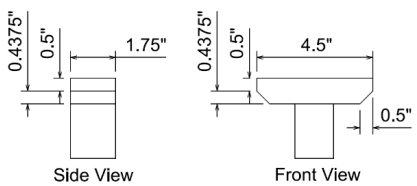
Specifications for Truss Bridge:



- The materials provided in the kit are the ONLY materials to be used when building the bridge structure. Any modifications to the structural properties of the balsa wood or using different glue than provided will result in judges recording zero (0) weight held.
- The instrument used for testing will be the Pitsco Structures Testing Instrument as seen on the right.
- Lamination is permitted in one layer only. Lamination is gluing two members along their length as shown in the picture on the right. If two laminated members are beside each other, there must be a minimum 0.125 inch gap maintained between them.
- If spacers are used between members, the spacer minimum spacing is 2 inches.
- Connections can be butt joints, miter joints, or notched joints. Lap splices are permitted, but no greater than 0.25 inch.
- End-to-end, the length of the entire bridge must be 16 inches.
- There is no height restriction on the bridge.
- The minimum width of the bridge shall be no less than 2.5 inches and the maximum width of the bridge shall be no more than 4.5 inches.
- A block of wood that is 14 inches long by 2 inches wide by 1 inch high must be able to be placed on the bridge deck as shown in the diagram below.
- Tester supports will be placed at 16 inches on center. Support dimensions are shown below.
- The bridge shall only touch the top of the Pitsco Tester Supports as seen in the diagram below. If the bridge touches any other part of the tester body, judges will record zero weight held.
- The bridge must have at minimum a 0.75 inch gap at mid-span both longitudinally and transverse to allow a 0.625 inch testing rod to pass through and attach to a 14 inch block of wood for strength testing as seen in the picture to the right and the diagram below. **The testing rod must be able to pass through the full height of the bridge to allow a wing nut to be screwed onto the rod as seen in the picture above.**

Tester Configuration Detail
Not representative of required design
Use only for dimension reference





Support Detail

PROPOSAL FORMAT:

The information below gives an indication of what the judges are looking for in each section.
The proposal must contain all of the sections outlined below to be considered for the competition.

I. BRIDGE PROPOSAL (See Page 4 for Assessment)

A. Proposal Format: The written proposal should be typed, double-spaced using a size 12 font of either Arial or Times New Roman on 8.5 x 11 paper with all pages numbered, 1" borders all around. Sections must be in order of the outline below:
B. Timeliness: Proposals received after the deadline will not be accepted.
C. Proposal Presentation: Portfolio **MUST** contain all the sections outlined below:

I. Title Page. Include name of challenge, team name, and team logo, name of school or organization, city and state, names of students, name of teacher or advisor.

II. Table of Contents.

III. Summary (abstract). Clearly and concisely stated. (At least ½ page, no more than two pages)

IV. Introduction. Indicate the team name, team members as well as the background of each member.

V. Body. The main part of the report. This may be divided into several sections (such as Design, Development, etc.). In general, this part should:

a) Explain the scientific principles behind your design.
b) Describe the challenges you encountered in designing your bridge
c) Include Data Tables, Graphic Representation of Tests, and supporting Calculations page.
d) Include scaled CAD drawings of preliminary and final bridge designs.
e) Include at least five pictures of team work during bridge design and construction, along with a picture of the constructed bridge (prototype or final).
f) Explain how you tested your design, and the improvements this led you to make.
g) Describe the challenges that you encountered in building your bridge and how you solved these problems. Include safety precautions, building methods, etc.

VI. Conclusions (and Recommendations). How successful is your project? What did you learn by taking part?

VII. Acknowledgments. List the names of the adults who assisted you in the project with a brief description of what they did. Include a certification, signed by all student team members and adults assisting, stating that: "We hereby certify that the majority of the ideas, design, and work was originated and performed by the students, with limited assistance by adults, as described above."

VIII. Bibliography. List all references used, including Internet, books and magazines.

IX. Appendices. They must include:

A. Scheduling and Accomplishments. Show on a timeline, or similar method, how you scheduled your project. Include *brie*f records of meetings.
B. Daily Journal. Progress reports of day-to-day work on the project, including date, performance, and comments from each team member.

PROPOSAL ASSESSMENT
2026 BRIDGE CHALLENGE PROPOSAL FORMAT

ALL PROPOSALS SHOULD FOLLOW THE FORMAT BELOW TO BE CONSIDERED FOR NATIONAL CHALLENGE

Proposal Format	Possible Points	Points Awarded
Typed	(1 point)	
Double Spaced	(1 point)	
12 Point Font (Arial or Times New Roman)	(1 point)	
All pages on 8.5 x 11 paper	(1 point)	
Information is in the proper order	(2 point)	
All pages are numbered	(1 point)	
Style and presentation	(1 points)	
Mechanics	(1 points)	
Visuals	(1 points)	

Score _____/ 10 Possible Points

Proposal Presentation		
Title page	(1 point)	
Table of Contents	(1 point)	
Summary (no more than 2 pages)	(5 points)	
Introduction	(1 points)	
Body		
o Sections of portfolio identified	(3 points)	
o Scientific principles of the design	(5 points)	
o Design challenges	(5 points)	
o Tables, Graphs, Calculations	(10 points)	
o Detailed scaled CAD drawings	(5 points)	
o Photos during and after construction	(5 points)	
o Testing and improvements	(5 points)	
Conclusion		
o Recommendations	(5 points)	
o Success of the project	(5 points)	
o What was learned by taking part	(5 points)	
Acknowledgements		
o Adults involved	(1 points)	
o Description of what the adults did	(1 points)	
o Certification and signatures	(1 points)	
Bibliography	(1 points)	
Appendices		
o Schedule on a timeline or similar	(5 points)	
o Daily Journals (must be legible)	(20 points)	

Score _____ / 90 Possible Points

TOTAL SCORE: _____/100 Points

BRIDGE COMPETITION FINALS

Each team will be expected to make a PowerPoint presentation and be able to answer questions from the panel of judges about their entry. Supporting materials may be presented to the judges. All technical drawings must be created using CAD Software. Judges will examine each entry to make sure it fits the specifications given in the rules. The bridge brought to competition must be similar with no major changes to the bridge in pictures labeled the competition bridge submitted in the portfolio. The criteria below outlines the competition fundamentals:

A. SPECIFICATIONS: Prior to testing, the bridge will be checked by the judges for adherence to the specifications on page three of this document. Specification violations will be discussed with the team prior to testing. Any bridge not meeting the specifications on page three will result in judges recording zero weight held.

B. ORAL PRESENTATION (50% of the total score): Teams will present a 10-minute PowerPoint presentation (a deduction is assessed for every minute under or over 10 minutes). A rubric on page 11 has been provided for the presentation as a guide.

C. PERFORMANCE (50% of the total score): Bridges will be weighed and then tested on the Pitsco structural tester. Results will be used to calculate strength-to-weight ratio.

PREPARING FOR COMPETITION

Form a team of interested students or friends. Discuss the challenges and design specifications. Teams shall consist of two students. Each team must have at least one teacher or other adult to help and advise, though a single adult may be advisor to more than one team.

Study the rules. The individual challenge documents and the grading criteria will give important information, which must be followed if your team is to achieve the best results. Failure to adhere to the rules could lead to penalties, or even disqualification. If any of the information is not clear, please call for additional help.

Plan the timing of the project. Ensure that everyone in the team knows the date for submission of the written report and recognizes that this means that all major development work should be finished before this date.

Keep records of meetings and working drawings carefully and give members of the team responsibility for different sections of the final report.

Notes to Adults: HDOT and STEMworks would like to stress that **the work on all phases of the project is to be done by the students**. Adult assistance is to be limited to:

- Mentoring
- Basic guidance of the students
- Teaching engineering, mathematical and scientific principles applicable to the project
- Guiding students in research
- Assisting in the production of the report and preparation of the drawings
- Overseeing the manufacturing stages of the project

Guidance should be in the form of asking questions, (leading questions if necessary) to promote creative thinking by the students to identify the scientific and engineering principles involved. ***Encourage students to consult creditable web sites and other resources*** to help with the project. ***Encourage students to test and improve their designs***. A good way to begin is for each student to design and/or construct a rough prototype. Test it and make improvements.

BRIDGE CHALLENGE SCHEDULE

1) Applications due **September 26, 2025**.

2) Packets will be shipped to teams by the STEM Outreach Solutions office by **November 10, 2025**. Packets will include:
    - Balsa Wood
    - Wood Glue
    - Graph Paper
    - Wax Paper
    - Pins
    - Safety Cutters

3) Proposals, saved as your state abbreviation, team name, and saved as a PDF, are due **February 6, 2026** (do not include the Bridge). Example: *[SchoolAbbrev]_[TeamNumber].pdf*

4) Notification of finalists by **March 6, 2026**.

5) Finals will be held at the **2026 Hawaii STEM Conference at the Sheraton Waikiki, Oahu on April 15th & 16th, 2026 .**

PROPOSAL ENTRY FORM
2026 HDOT x STEMworks BRIDGE COMPETITION
Grades 11 and 12

Return to Chelsea Kau by February 6, 2026

Entry form for report proposal (saved as School Abbreviation, team name/number and in a PDF format*) for:

Name of Adult Advisor_____

Team Name_____

Team Members Name & Grade Levels (Team members must be in 11th or 12th grade)

1._____

2._____

School or Group_____

Address_____

City_____State_____Zip_____

Work Phone_____Home Phone_____

Cell Phone_____Fax Phone_____

E-mail address (required)_____

Return completed form through email to:
Julia Smith

Email: ckau@gotoetc.com

Example report proposal name: *[SchoolAbbrev]_[TeamNumber].pdf***

GUIDELINES

2026 HDOT x STEMworks BRIDGE COMPETITION

Oral PowerPoint Presentation: Bridge Competition

Team Name _____

NOTE: This is a rubric to help with the preparation of the presentation. Oral presentation has a possible score of 100 points. Each category will be judged on a scale from 1 to 20 points.

CATEGORY	20	15	10	5	0	Sub-Score
Content	Covers topic in-depth with details and examples. Subject knowledge is excellent.	Includes essential knowledge about the topic. Subject knowledge appears to be good.	Includes essential information about the topic but there are 1-2 factual errors.	Content is minimal OR there are several factual errors	Did not fulfill requirements	_____/20
Mechanics	No misspellings or grammatical errors.	Three or fewer misspellings and/or mechanical errors	Four misspellings and/or grammatical errors.	More than 4 errors in spelling or grammar.	Did not fulfill requirements	_____/20
Organization	Content is well organized using headings or bulleted lists to group related material.	Uses headings or bulleted lists to organize, but the overall organization of topics appears flawed.	Content is logically organized for the most part.	There was no clear or logical organizational structure, just lots of facts.	Did not fulfill requirements	_____/20
Presentation	Interesting, well-rehearsed, few to no glances at presentation and/or notecards, with smooth delivery that holds audience attention.	Relatively interesting, rehearsed, glancing frequently to presentation and/or notecards, with a fairly smooth delivery that usually holds audience attention.	Delivery not smooth, read from presentation and/or notecards but able to hold audience attention most of the time.	Delivery not smooth, read from presentation and/or notecards and audience attention lost.	Did not fulfill requirements	_____/20
Attractiveness	Makes excellent use of font, color, graphics, effects, etc. to enhance the presentation.	Makes good use of font, color, graphics, effects, etc. to enhance the presentation.	Makes use of font, color, graphics, effects, etc. but occasionally these distract from the presentation content.	Use of font, color, graphics, effects etc. but these often distract from the presentation content.	Did not fulfill requirements	_____/20
					Total Sub-Score	_____/100
					Each Minute Under/Over 10 Minutes: (-10)	_____
					TOTAL SCORE	_____

2026 HDOT x STEMworks BRIDGE COMPETITION
Suggestions and Helpful Hints

1. Students should be prepared for questions at the end of the presentation.
   These questions may be concentrated in the following topics. However, note that the judges are free to ask any question about any topic. Therefore, each team should be prepared.
   a) Choice of design
   b) Civil engineering careers related to bridges
   c) Safety
   d) Impacts of bridges
   e) Lessons learned

2. Stay organized and keep track of time limits.

3. If you have a question, ASK. Students and parents communicate to teacher/advisor and teacher/advisor communicate with Chelsea Kau at ckau@gotoetc.com .

4. Contact your DOT engineers. They will answer many of your questions.

5. Check out other bridges in your area or around the world

6. **Include detailed information in the team portfolio. Remember, your portfolio is what determines if your team is selected to come to national competition.**

7. RESEARCH